

within the range of weekly average and weekly maximum temperatures at permanent stations located in the 4 reaches (Figures 6, 7, 8, and 9). The similarity of segment and station water temperatures indicate that dive surveys were conducted under conditions characteristic of a reach.

The distribution of steelhead was correlated with water temperatures and there was a significant difference in temperatures collected at dive survey sites among reaches (ANOVA F-Ratio = 3.13,  $p=0.038$ ). Survey site maximum temperatures in the Ukiah and Canyon reaches were 22°C and 22.5°C, respectively (Figure 10). These temperatures were above the 20.5°C suitable temperature condition for young steelhead; however, steelhead observed during Russian River dive surveys appeared healthy and vigorous, and not stressed or lethargic from high water temperatures. The highest temperatures occurred in the Alexander Valley and Healdsburg reaches at 25°C and 24°C, respectively (Figure 10). Prolonged exposure of steelhead at these temperatures may result in behavioral changes or mortality.

## **Reach Habitat and Fish Abundance**

### **Ukiah Reach**

The Ukiah reach is located in Ukiah Valley area and is the upstream limit of the study area. The reach extends 33 km from the confluence of the East and West Forks of the Russian River to Highway 101 Bridge near Hopland and contained 12 sample segments. Land use along the river consists of vineyard and orchard outside of the riparian zone and occasional aggregate mining along the gravel bars. Also, Norgard Dam is located in the upper portion of Ukiah reach, approximately 1 km downstream from the Talmage Road Bridge. This dam is approximately 3 m high and is the only dam along the reach. Elevation in the reach ranged from 143 m to 186 m, a change of 43 m (Figure 2). See Figures 5 through 17 in the Appendix for photographs of the reach.

The habitat characteristics in the survey segments ranged from a mosaic of well-developed riparian forest along an incised channel to a moderately broad channel with exposed gravel bars and adjacent riparian forest. Flatwater was the dominant habitat throughout the reach and consisted of 94% of the sampled reach, while other habitats included 0.8% deep pool, 5% riffle, and 0.2% cascade (Figure 2). Fastwater habitat (i.e., riffle and cascade) occurred in the upper portion of the reach while the lower reach was entirely flatwater (Figure 11). Cascade habitat occurred in 2 segments, including the upstream end of the reach at U1 and at the Norgard Dam located in U4. The cascade at Norgard Dam consisted of riprap boulders and concrete slabs below the dam (see Figure 9 of the Appendix). Deep pool habitat was concentrated in the central portion of the reach and the largest pool was located below Norgard Dam. The 4 downstream segments (U9-U12) consisted entirely of flatwater habitat.

The fish composition of the Ukiah reach included several native and non-native fish common in the Russian River (Figure 2). A total of 20,117 fish were counted during dive surveys in 12 segments. Cyprinids (minnow species) and Sacramento sucker dominated the composition at 54% and 36% of the fish observed, respectively. A total of 224 steelhead were observed in the reach contributing 1% of the fish counted. Steelhead were present in 3 segments located in the upper one-third of the reach and were correlated with the distribution of riffle and cascade

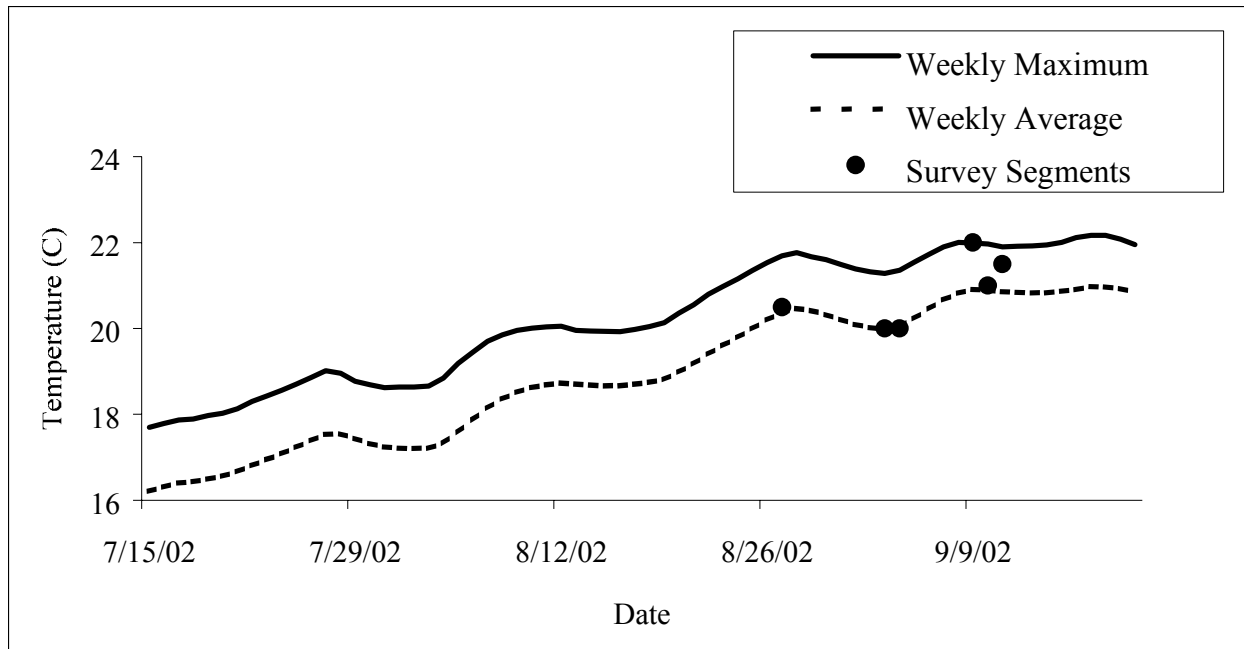


Figure 6: Water temperatures, Ukiah reach. Temperatures recorded continuously at a permanent station near Hopland and at sample segments during dive surveys.

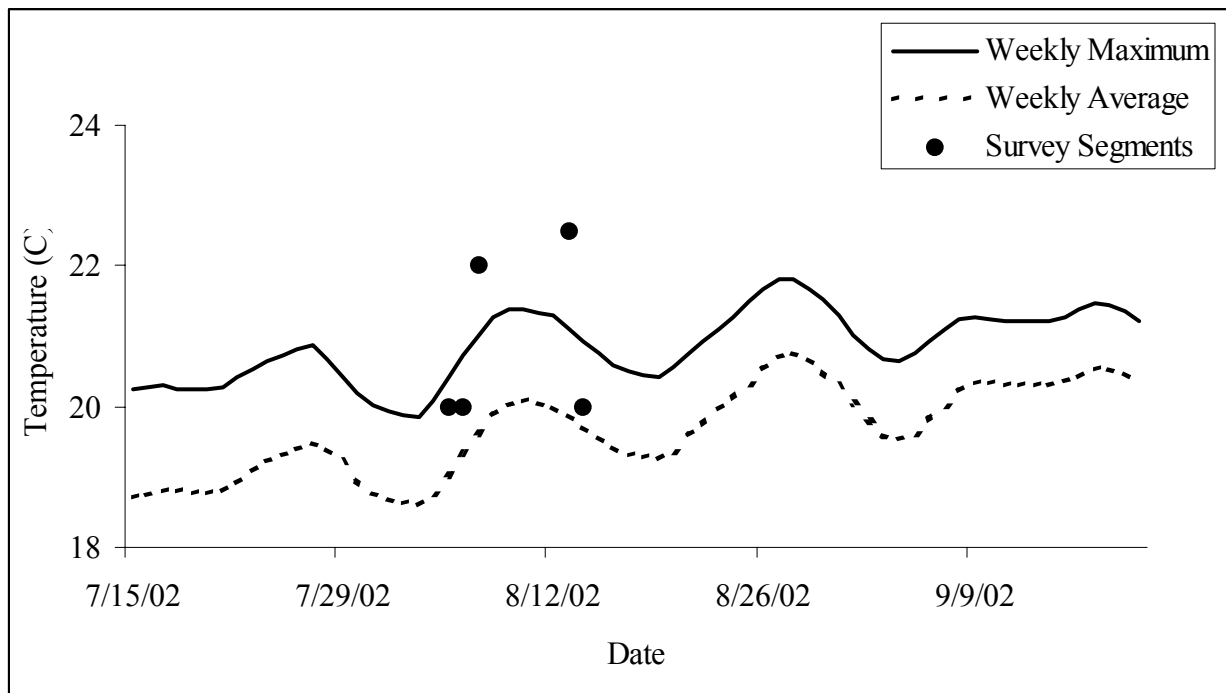


Figure 7: Water temperatures, Canyon reach. Temperatures recorded continuously at a permanent station at Comminsky Road and at sample segments during dive surveys.

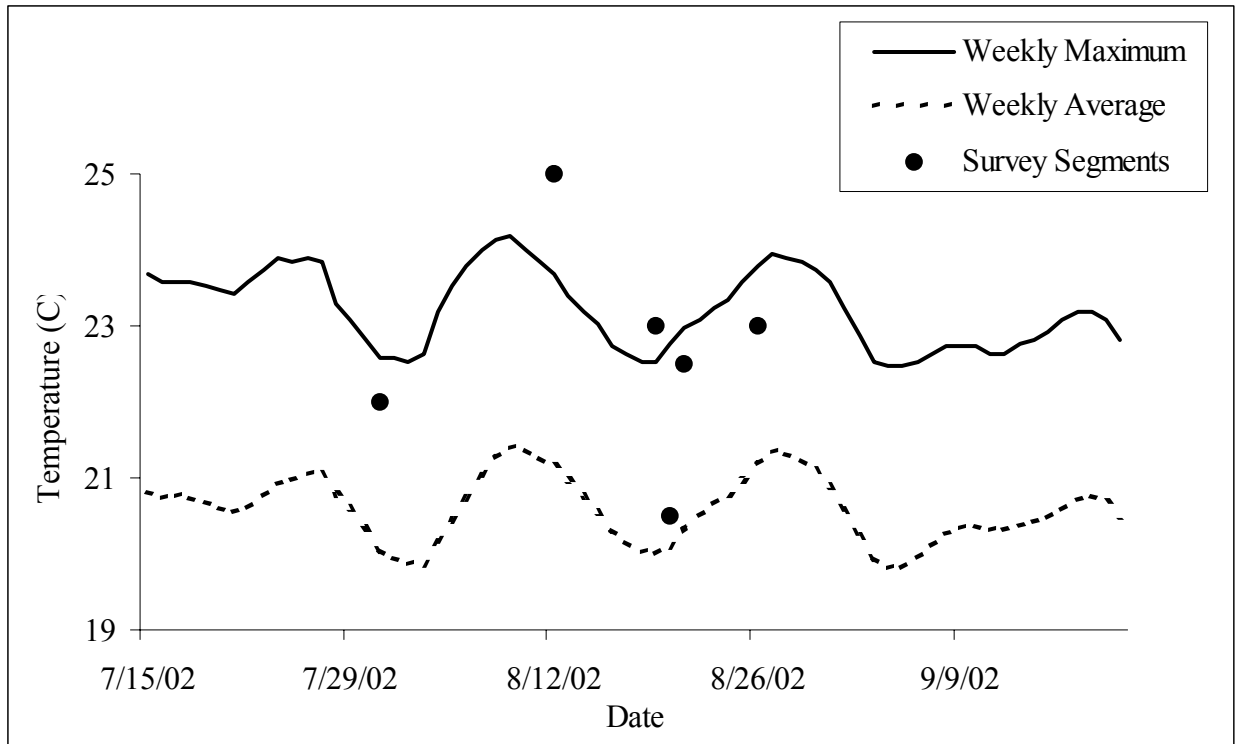


Figure 8: Water temperatures, Alexander Valley reach. Temperatures recorded continuously at a permanent station near Cloverdale Airport and at sample segments during dive surveys.

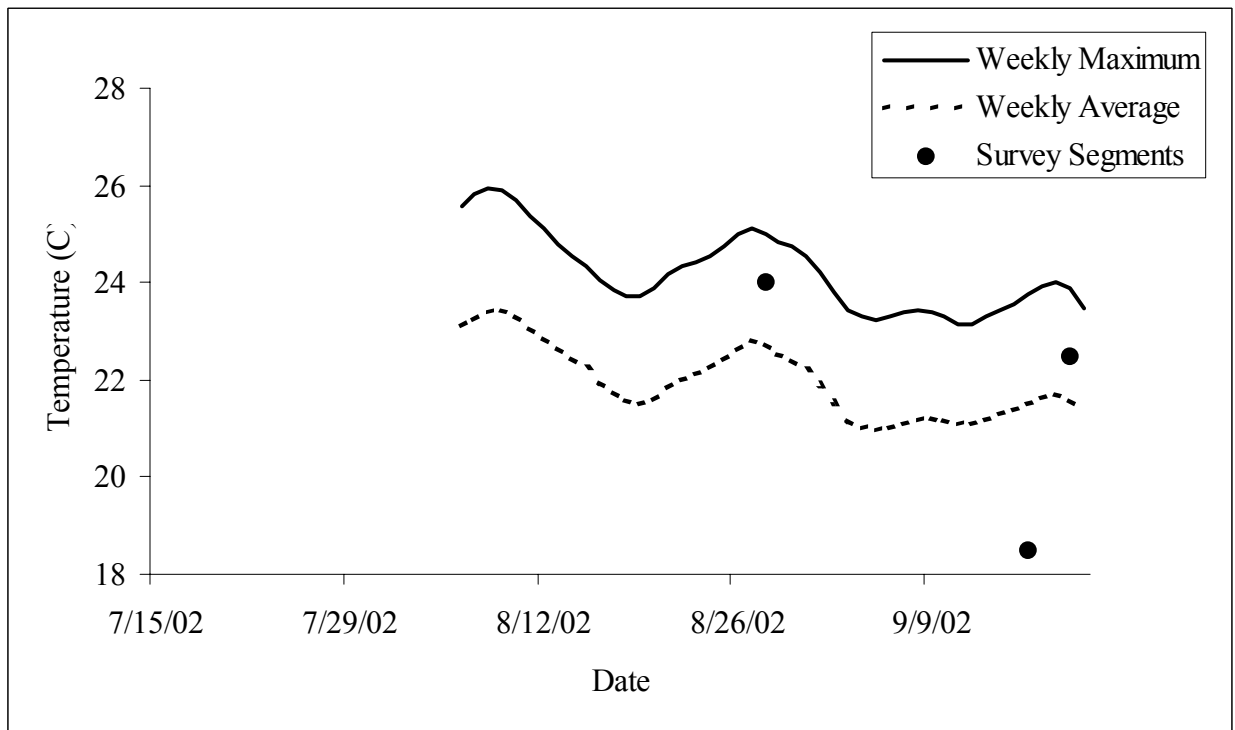


Figure 9: Water temperatures, Healdsburg reach. Temperatures recorded continuously at a permanent station at Digger Bend near Healdsburg and at sample segments during dive surveys.

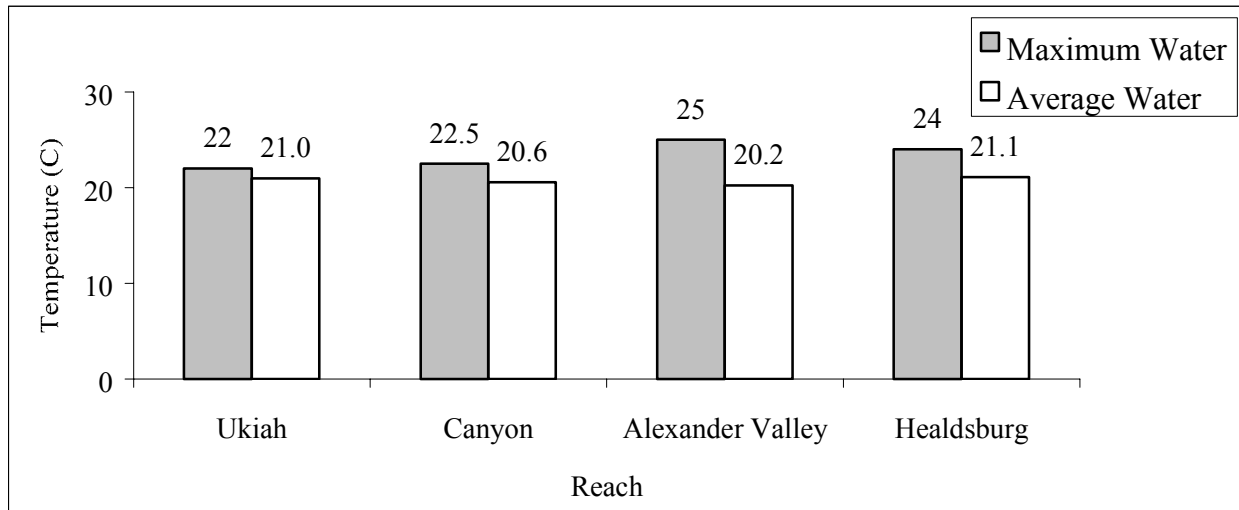


Figure 10: Maximum and average water temperatures at sample sites by reach. Temperature data collected during daytime dive surveys. Water temperatures differed significantly among reaches (ANOVA F-Ratio = 3.13,  $p=0.038$ ).

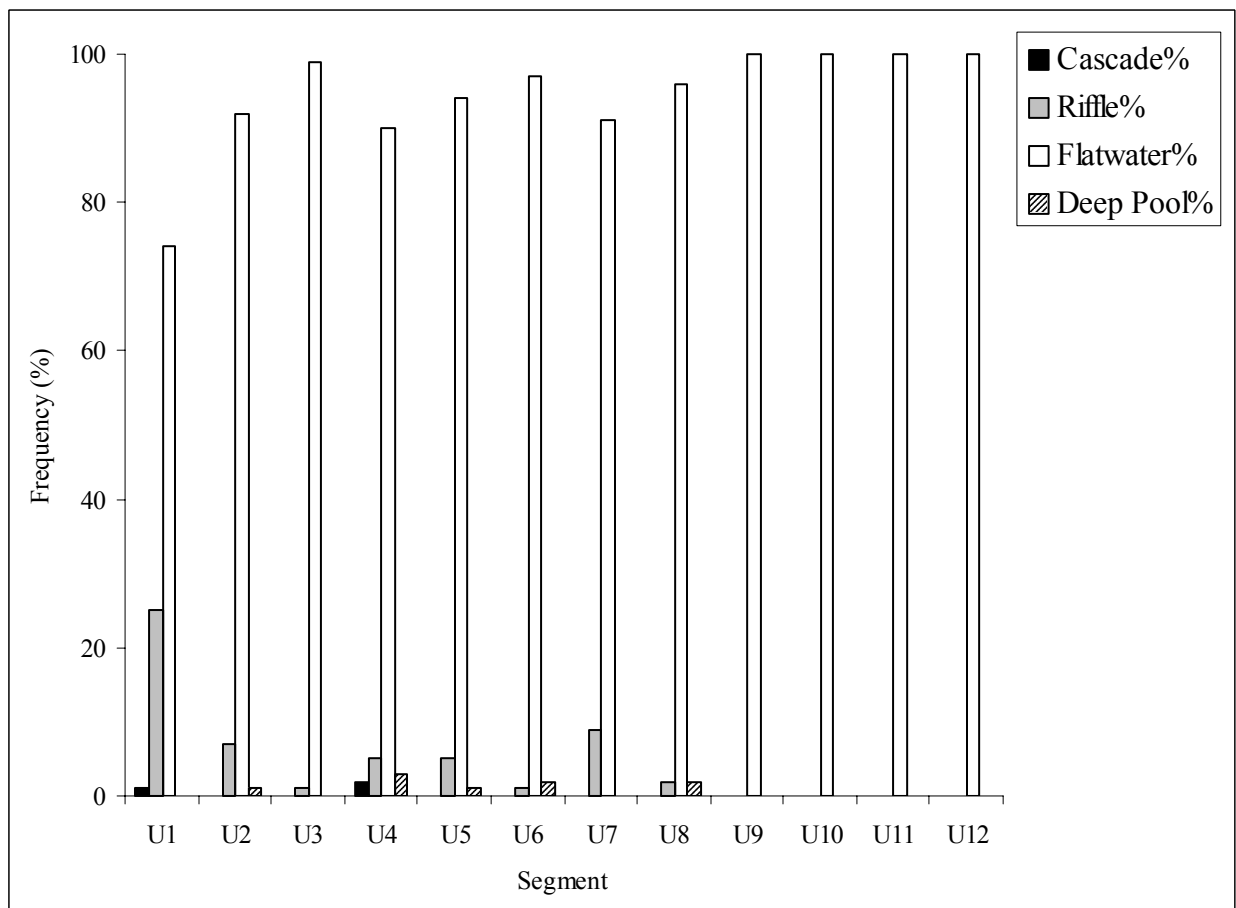


Figure 11: Habitat types, Ukiah reach. Habitat percent based of visual estimates.

habitats (Figures 11 and 12). Segment U1, where 55 steelhead were observed, contained cascade habitat and the highest percentage of riffle habitat in the reach. Segment U2 contained the third highest percentage of riffle and 7 steelhead were counted. Segment U4 had the largest count of steelhead at 161, contained riffle habitat, and the highest percentage of cascade habitat located at Norgard Dam. As shown in Figure 12, 3 steelhead age groups were present in the reach and most steelhead were 1+ fish (64%) followed by young-of-the-year (35%) and 2+ fish (1%). The disproportionately high frequency of 1+ fish suggests a relatively large population of resident steelhead.

### Canyon Reach

The Canyon reach is located between Highway 101 Bridge near Hopland and the confluence with Big Sulphur Creek near Cloverdale. The reach included 9 sample segments along 21 km of river. Land use in the area is primarily rangeland and transportation routes. Highway 101 and Northwestern Pacific Railroad tracks parallel the river on either side. The Russian River in this reach flows through a steep canyon with the highest gradient of the 4 study reaches. Elevation in the reach ranges from 90 m to 143 m; however most of the gradient change in the river occurs in the lower two-thirds of the reach below Squaw Rock from segments C4 to C9 (Figure 2). Figures 18 through 26 in the Appendix show photographs of the reach.

The habitats in the Canyon reach varied from deep pool to cascade habitats, and included the highest proportion of fastwater habitat of any reach (Figure 13). The 3 upper segments (C1-C3) of the reach were composed almost entirely of flatwater habitat with well-developed riparian vegetation and were similar in character to the lower portion of the Ukiah reach. The lower 6 segments (C4-C9) were characterized by steep canyon topography, fastwater habitats with a substrate dominated by boulder and bedrock, and patchy riparian vegetation. The fastwater habitat in the reach included 16% riffle and 0.2% cascade. Segments C4, C6, and C9 had the highest occurrence of riffle habitat at 27%, 28%, and 50%, respectively. Cascade habitat occurred at C4 located at Squaw Rock and consisted of 2% of the segment. Deep pool habitat occurred from C3 through C9 and ranged from 1% to 8% of the segment. These pools were generally formed by boulders or bedrock structures.

A total of 24,398 fish were counted in the 9 segments of the Canyon reach for an average of 2,711 fish/segment. Cyprinids (i.e., California roach, pikeminnow, and hardhead) were the most abundant fish at 60% of the fish count followed by Sacramento sucker (25%) and Russian River tuleperch (9%). Steelhead observations included 1,194 fish and consisted of 5% of the total fish count. The age classes of steelhead, based on size categories, were 69% young-of-the-year and 31% 1+ age fish (Figure 14).

Steelhead were distributed throughout the reach except for the upstream segment (C1); however, most steelhead were observed in fastwater habitats located in the lower two-thirds of the reach where the gradient is relatively high. Steelhead numbers were zero or very low in segments C1 through C3 where the habitat was primarily flatwater (Figures 13 and 14). In contrast, steelhead observations were relatively high in segments C4 through C9 where fastwater habitats were abundant. The largest steelhead counts were in segment C5 at 435 fish followed by C6 and C7 at 254 and 210 fish, respectively.

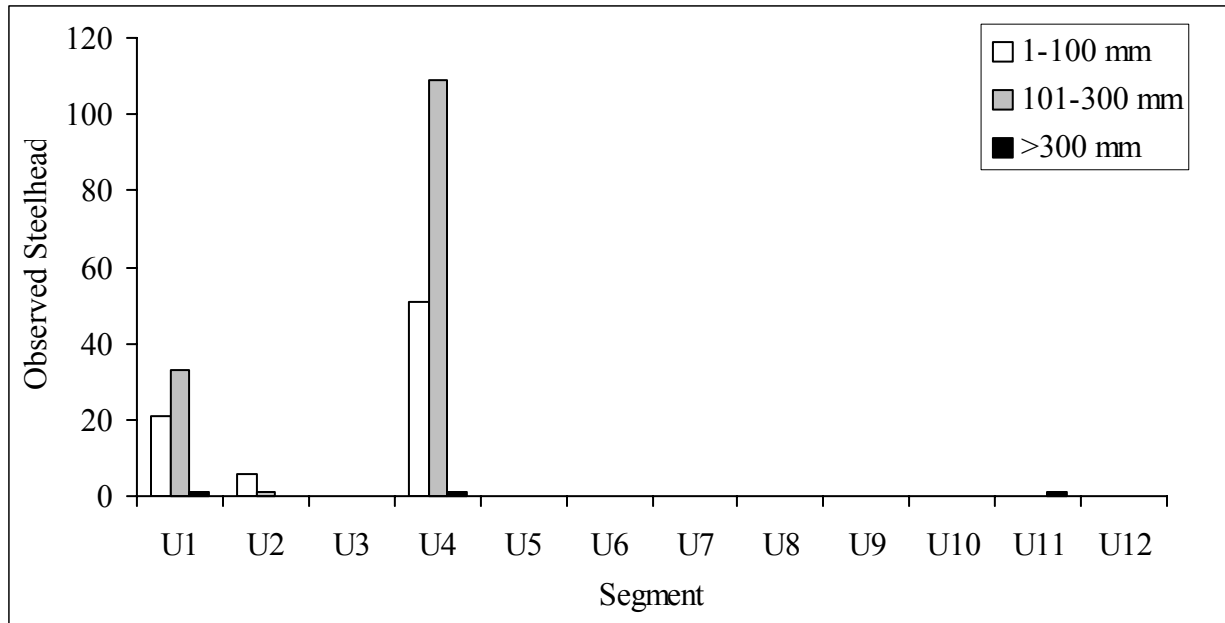


Figure 12: Steelhead abundance and size distribution, Ukiah reach. Fish counts and size categories are based on visual dive surveys and are not population estimates.

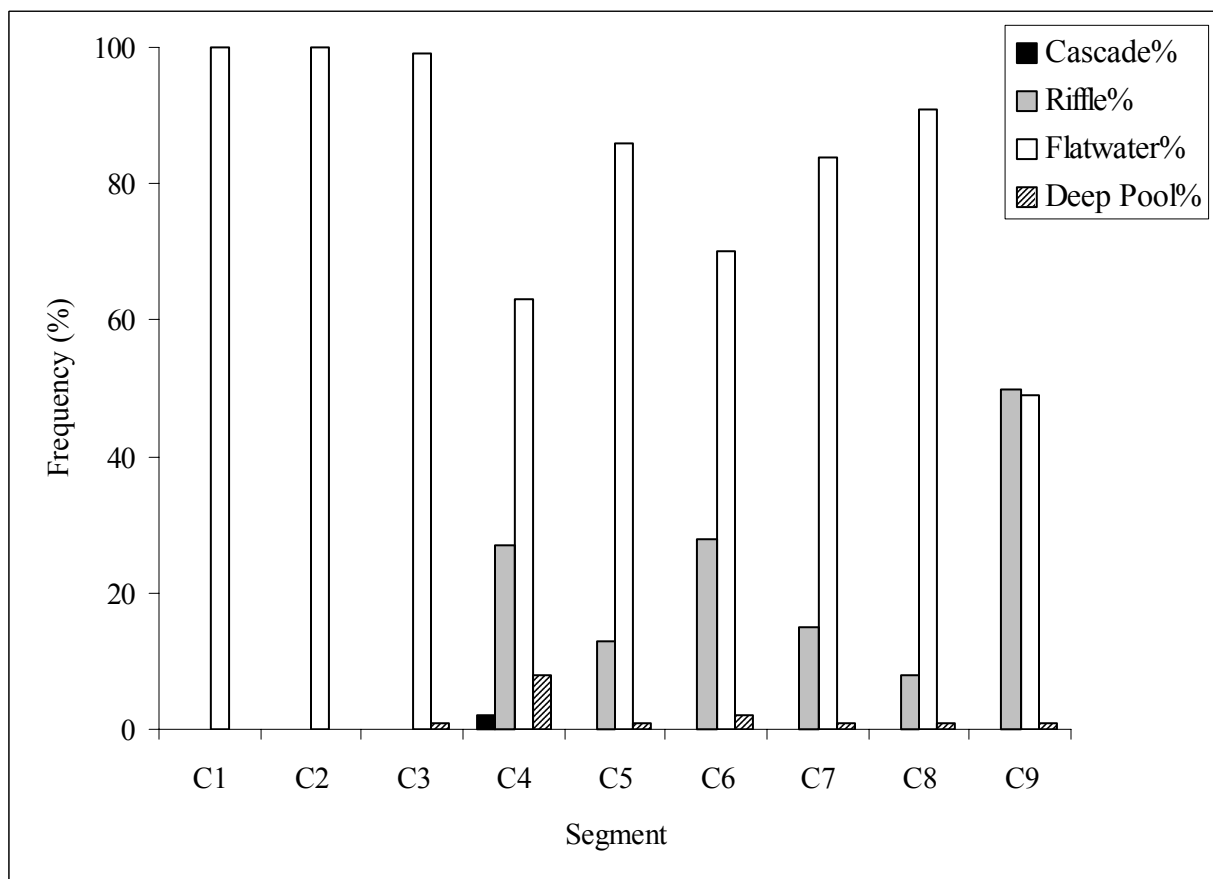


Figure 13: Habitat types, Canyon reach. Habitat percent based of visual estimates.

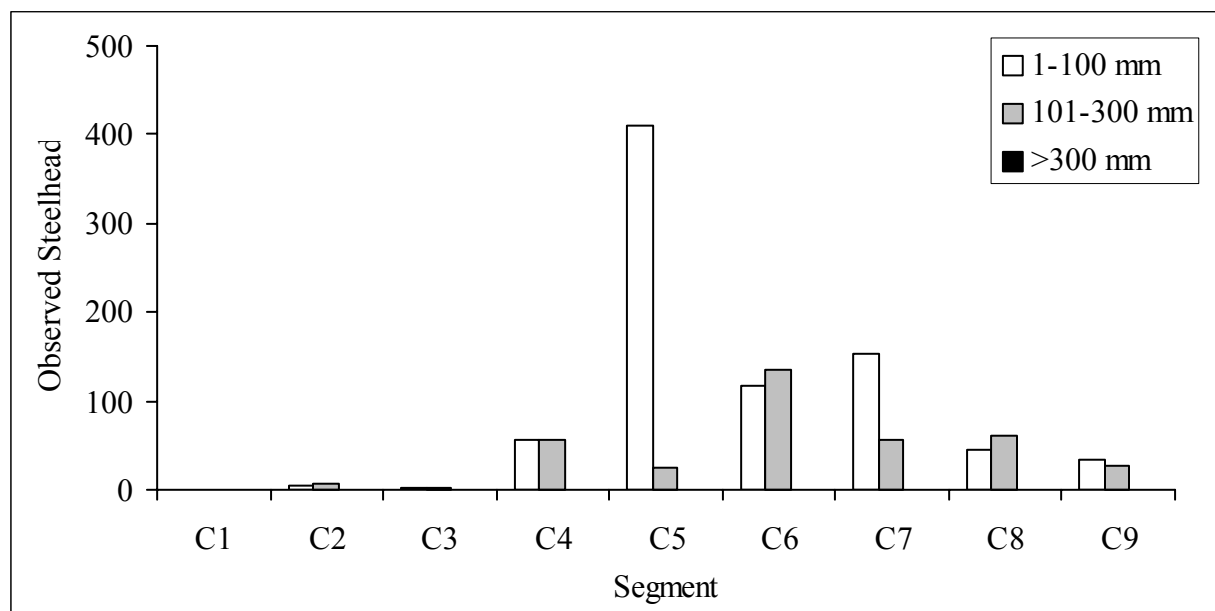


Figure 14: Steelhead abundance and size distribution, Canyon reach. Fish counts and size categories are based on visual dive surveys and are not population estimates.

The largest count of steelhead did not correlate with the highest frequency of fastwater habitat, as expected. Segment C9 contained the highest proportion of riffle habitat at 50% and had 59 observed steelhead, while C5 through C7 had steelhead counts several times this amount and less than half of the fastwater habitat. One explanation for the distribution of young steelhead within riffles is the presence of refugia from excessive water velocities. Large substrate particles in high gradient areas provide important shelter for fish from high velocities. The substrate in C9 riffles was primarily loose cobble while C4 through C7 riffle substrate was dominated by boulder and bedrock.

### Alexander Valley Reach

The Alexander Valley reach is located in Alexander Valley and extends from the confluence of Big Sulphur Creek near Cloverdale to the Alexander Valley Road Bridge. The length of the reach was approximately 26 km and included 11 sample segments. Land use along the reach consists of agricultural land (vineyard) outside of the riparian zone and occasional aggregate mining along the gravel bars. Elevation ranges from 59 m to 90 m and has the lowest gradient of all the study reaches (Figure 2). See Appendix Figures 27 through 37 for photographs of the reach.

The Alexander Valley reach consists of a slow-moving meandering river in a broad channel with exposed gravel bars and dense riparian vegetation along the outer banks. Flatwater was the dominant habitat and consisted of 91% of the reach, while other habitats included 0.8% deep pool, 8% riffle, and 0.2% cascade (Figures 2). Segments A1-A6 and A9-A11 contained almost entirely flatwater habitat (Figure 15). Segments A7 and A8 had relatively high proportions of riffle habitat at 60% and 15%, respectively. Riffle habitats were characterized by fast flows in a

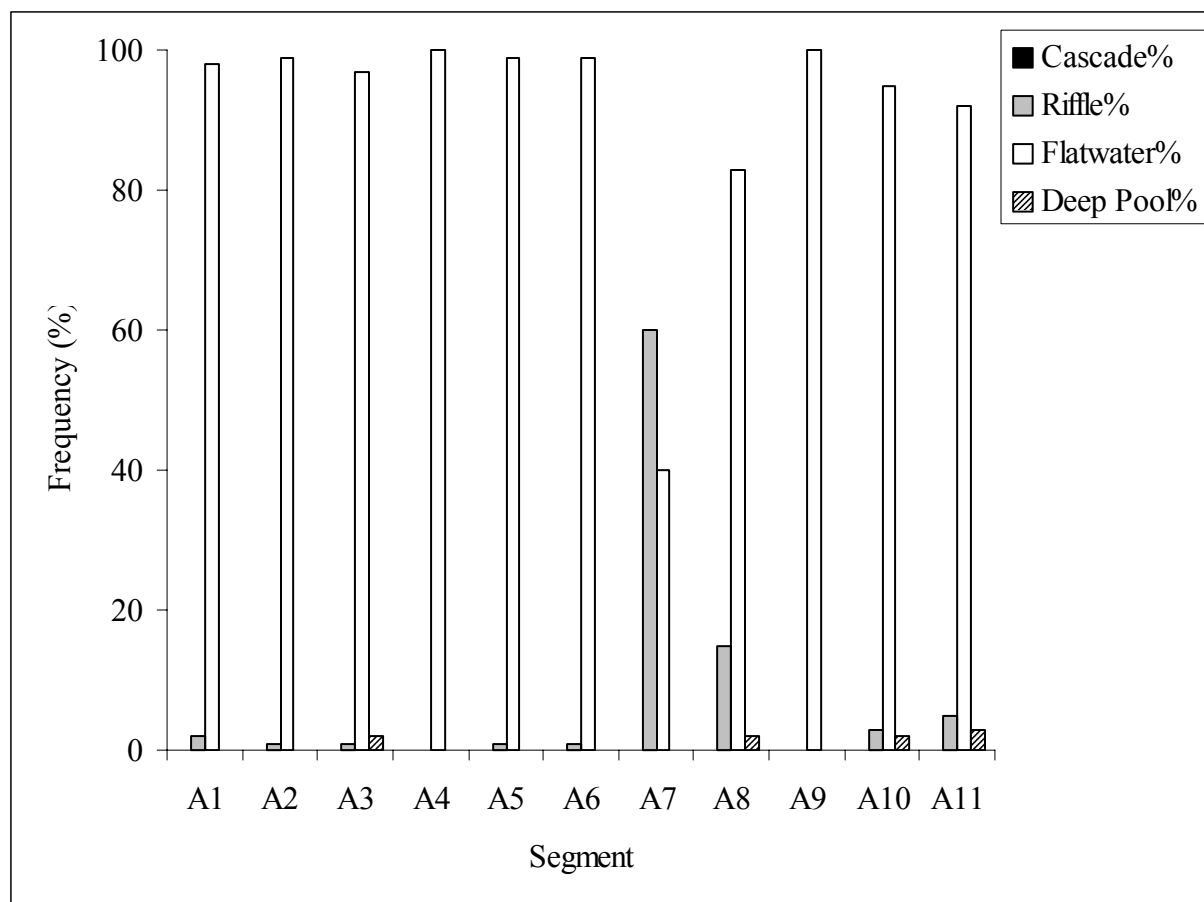


Figure 15: Habitat types, Alexander Valley reach. Habitat percentages based of visual estimates.

broad and shallow channel with unconsolidated large gravel to cobble substrate. Deep pools occurred in 4 segments distributed throughout the reach.

The fish composition of the Alexander Valley reach contained several native and non-native fish common in the Russian River (Figure 2). A total of 43,009 fish were counted during dive surveys for an average of 7,820 fish/km. Cyprinids (minnow species) were the most abundant species in the reach and composed 74% of the fish count. Other common species included Sacramento sucker (19%) and Russian River tuleperch (6%). One steelhead was observed in the entire reach in segment A7 (Figure 16), which had the highest occurrence of riffle habitat at 60%. Riffles in this segment were broader, shallower, and contained smaller substrate size than riffles in other reaches that contained relatively high numbers of steelhead.

### Healdsburg Reach

The Healdsburg reach is the downstream end of the study area and extends 26 km from Alexander Valley Road bridge to the confluence with Dry Creek south of Healdsburg. A total of 5 segments were sampled in this reach. The lowland topography in the area includes Alexander Valley and Dry Creek Valley at the upper and lower ends of the reach. The central portion of the reach makes several large bends around Fitch Mountain and surrounding hills. The river gradient is low and similar to Ukiah and Alexander Valley reaches (Figures 2 and 4). The elevation ranges from 24 m to 59 m. In the upper and lower portions of the reach surrounding land use is



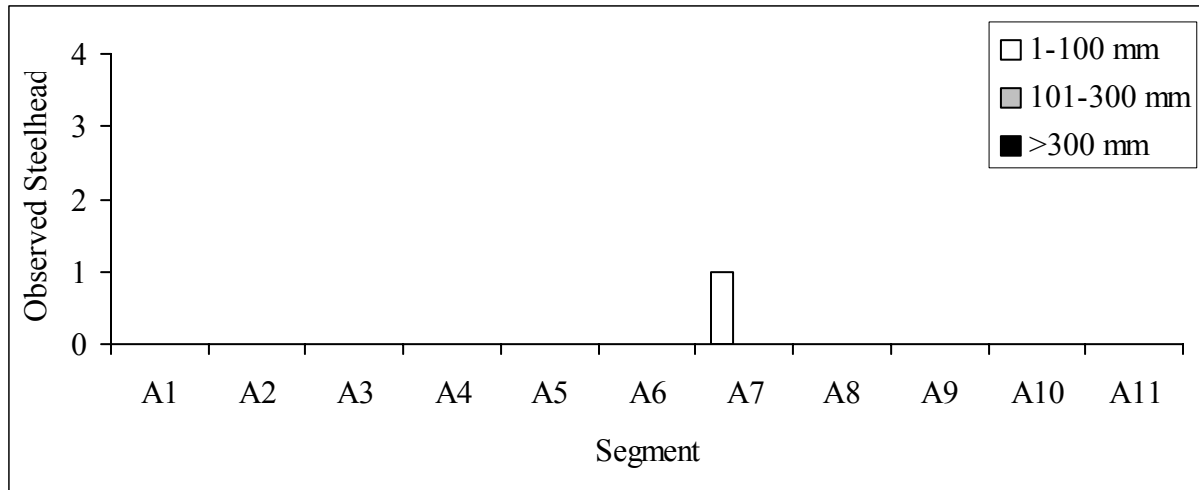


Figure 16: Steelhead abundance and size distribution, Alexander Valley reach. Fish counts and size categories are based on visual dive surveys and are not population estimates.

vineyard and aggregate mining. The hilly central portion of the reach is undeveloped land and rural residences along the banks of the river. Also, Healdsburg Dam is located in the lower portion of the reach. The dam is approximately 5 m high and impounds water above the dam for approximately 2 km upstream. Photographs of the reach are shown in Figures 38 through 47 of the Appendix.

River habitat in the Healdsburg reach is similar to Alexander Valley reach and consists of a slow-moving meandering river in a broad channel with exposed gravel bars and dense riparian vegetation along the outer banks. Habitat in the reach consisted of 93% flatwater, 2% deep pool, 4% riffle, and 1% cascade (Figure 2). Flatwater was the dominant habitat in the reach, while low frequencies of riffle and deep pool habitats occurred throughout the reach (Figure 17). Cascade habitat was present at a single site in segment H10. This cascade is an artificial feature created by large boulder riprap at Healdsburg Dam.

The fish assemblage in the Healdsburg reach was similar to the flatwater-dominated reach of Alexander Valley (Figure 2). A total of 5,497 fish were counted during dive surveys at an average of 2,199 fish/km. Cyprinids were the most abundant fish species in the reach and composed 48% of the fish count followed by Sacramento sucker (40%) and smallmouth bass (9%). Steelhead consisted of 0.3% of the fish count and a total of 17 steelhead were observed (Figure 18). Steelhead were observed in riffle and cascade habitats in 2 segments. One steelhead was observed in H6, which had 3% riffle habitat. Sixteen steelhead were counted in 2 fastwater habitats in H10, including the artificial cascade at Healdsburg Dam and a narrow riffle created by the Syar summer bridge crossing located approximately 400 m below Healdsburg Dam.

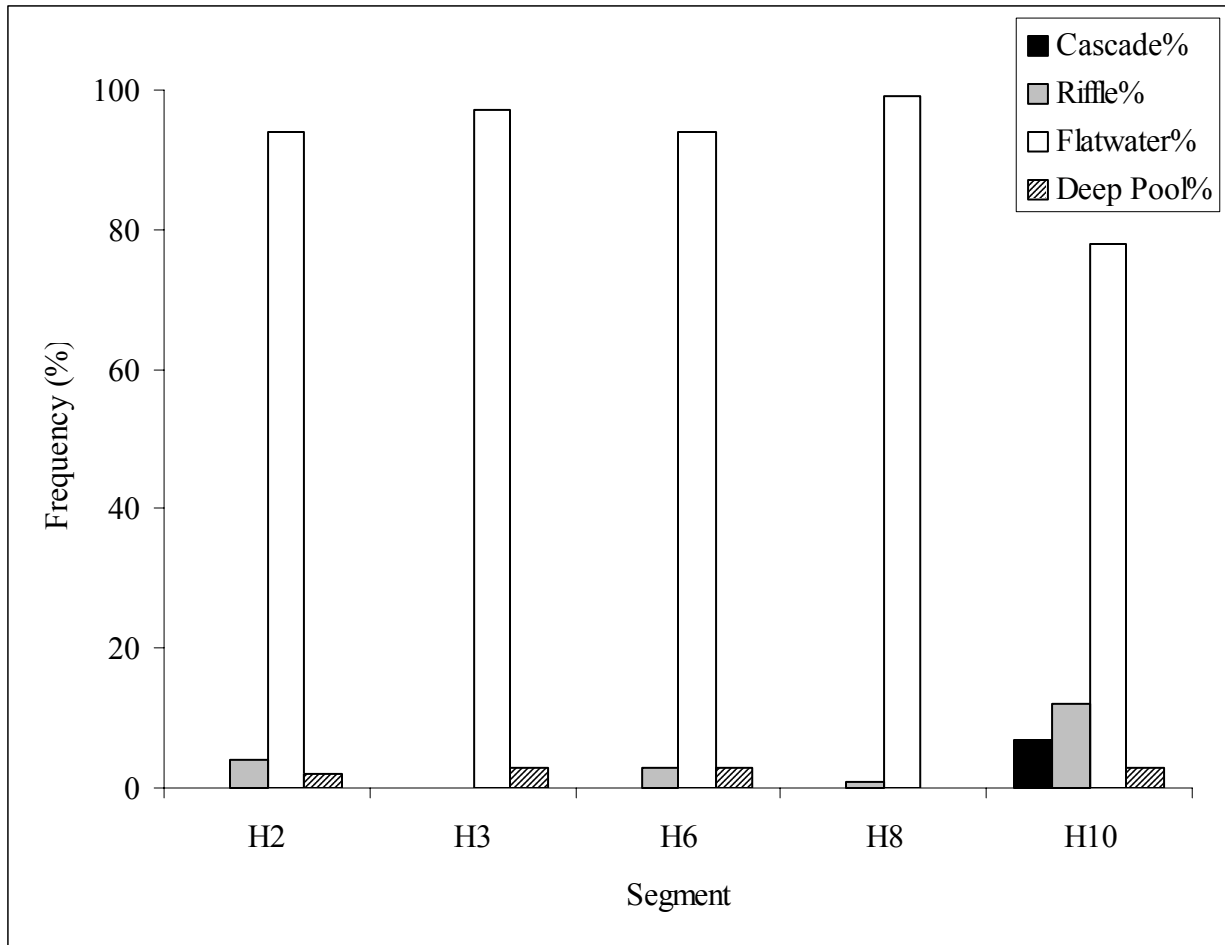


Figure 17: Habitat types, Healdsburg reach. Habitat percentage based of visual estimates.

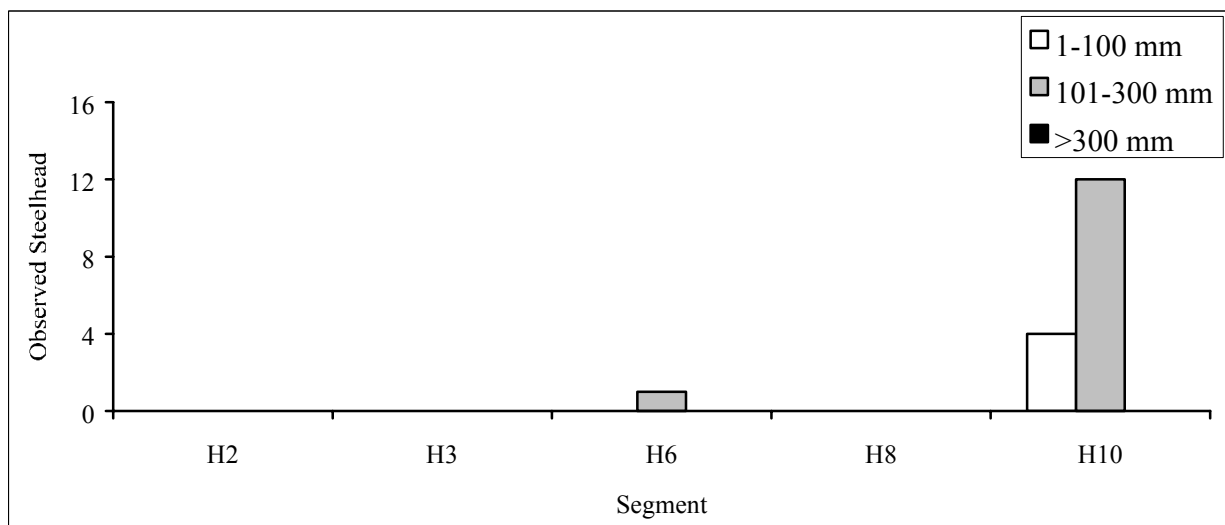


Figure 18: Steelhead abundance and size distribution, Healdsburg reach. Fish counts and size categories are based on visual dive surveys and are not population estimates.